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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/504,623	02/15/2000	Kazuhito Tsukagoshi	2369/25	8134

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WASHINGTON, DC 20005

EXAMINER

DOLAN, JENNIFER M

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 11/29/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/504,623

Applicant(s)

TSUKAGOSHI ET AL.

Examiner

Jennifer M. Dolan

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 September 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7, 13-23 and 25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 13-23, 25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This action is in response to Amdt. B, filed 9/16/02

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 2, 3, 13, 14, 21, 23, and 25 are rejected under 35 U.S.C. 102(b) as being anticipated by the IEEE Transactions on Magnetics article to Schwarzacher et al.

Regarding claim 1, Schwarzacher discloses a magnetoelectric device (page 3133, column 1, paragraph 1, column 2, paragraph 3); responsive to an applied magnetic field (figure 15), comprising first and second ferromagnetic regions (Co layers in figure 14) with a channel region between them (Cu regions in figure 14), the ferromagnetic regions being configured so that charge carriers with a particular spin polarization which can pass through the first region pass through the second region as a function of the relative orientations of magnetization of the ferromagnetic regions produced by the applied magnetic field (represented by the magnetoresistance; figure 15; page 3146, paragraphs 1 and 2) whereby the device exhibits a conductivity as a function of the strength of the applied field (figure 15), the channel region being configured to provide a quasi-one-dimensional channel (figure 14) to cause charge carriers which pass through the first ferromagnetic region to maintain their spin polarization as they pass towards the second ferromagnetic region (inherent property of the quasi-one dimensional tube).

Regarding claim 2, Schwarzacher discloses that the channel region includes a nanotube (figure 14; page 3133, paragraph 3).

Regarding claim 13, Schwarzacher discloses a magnetoelectric device (page 3133, column 1, paragraph 1; column 2, paragraph 3; figure 14) responsive to an applied magnetic field (figure 15), comprising first (bottommost Co layer in figure 14) and second (topmost Co layer in figure 14) ferromagnetic regions with a channel region (Cu layers) between them wherein the channel region includes a nanotube (page 3133, paragraph 3; figure 14).

Regarding claims 3 and 14, Schwarzacher discloses a bundle of nanotubes (figure 14).

Regarding claim 18, Schwarzacher discloses that the ferromagnetic regions comprise layers on a common substrate (figure 14).

Regarding claim 21, Schwarzacher discloses that the first and second ferromagnetic regions are made of a cobalt-containing material (figure 14).

Regarding claims 23 and 25, Schwarzacher discloses a magnetic reading head for reading data from magnetic storage media (page 3133, paragraphs 1 and 2).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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4. Claims 1 and 18-20 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,654,566 to Johnson in view of Schwarzacher et al.

Regarding claim 1, Johnson discloses a magnetoelectric device responsive to an applied magnetic field (column 7, line 67- column 8, line 3), comprising first (110) and second (116) ferromagnetic regions with a channel region (112) between them (figure 4). The ferromagnetic regions are configured so that charge carriers with a particular spin polarization which can pass through the first region, pass through the second region as a function of the relative orientations of magnetization of the ferromagnetic regions produced by the applied magnetic field (column 10, lines 17-21 and column 7, line 64-column 8, line 3). Because the strength of the applied field directly determines the degree to which the ferromagnetic field (116) magnetically aligns with the external field, and because the conductivity varies with the orientation of the second ferromagnetic region (116) relative to the first ferromagnetic region (110) (column 10, lines 17-21), it is an inherent property of the magnetoelectric device of Johnson that the conductivity is a function of the strength of the applied field.

Johnson fails to teach a quasi-one-dimensional channel.

Schwarzacher discloses a quasi-one dimensional channel between ferromagnetic regions (figures 14 and 15; page 3133, column 2, paragraph 3; page 3145)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the magnetoelectric device of Johnson to include the quasi-one-dimensional channel taught by Schwarzacher. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to provide a quasi-one dimensional channel in order to achieve a much higher magnetoresistance and greater compactness than is

obtained for a device not using a quasi-one dimensional channel (Schwarzacher, page 3146, column 2; figure 15; page 3149; column 2).

Regarding claim 18, Johnson discloses that the first and second ferromagnetic regions comprise layers on a common substrate (figure 2).

Regarding claim 19, Johnson discloses a substrate (204) made of silicon (column 11, line 58), covered with an insulating layer (202) on which the ferromagnetic layers are formed (figure 6b).

Regarding claim 20, Johnson teaches that the insulating layers are made of a silicon oxide (column 11, line 57).

Regarding claim 22, Johnson discloses a gate (206) to apply a field to a channel region (column 11, line 63-column 12, line 2).

5. Claims 4-7 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schwarzacher et al. in view of Journal of Experimental and Theoretical Physics article by Tsebro et al. (cited by applicant).

Regarding claims 4 and 15, Schwarzacher fails to disclose a nanotube made of carbon.

Regarding claim 5, Schwarzacher fails to disclose a quasi-one dimensional channel made of a carbon-containing material.

Tsebro discloses a carbon nanotube (column 1, lines 1-2).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of Schwarzacher to include a carbon nanotube, as taught by Tsebro. The rationale is as follows: One of ordinary skill in the art at the time the invention was

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made would have been motivated to specify that the nanotubes are made of carbon, as taught by Tsebro, because carbon nanotubes provide conductivity and transport characteristics suitable for channel materials (Tsebro, column 2, lines 1-3 and column 3, lines 36-38).

Regarding claim 6, Schwarzacher fails to disclose that the channel region comprises a layer of graphite.

Tsebro teaches that the carbon nanotubes comprise a layer of graphite (column 3, lines 21-23).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of Schwarzacher by including a graphite layer in the channel, as taught by Tsebro. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to provide a layer of graphite in the carbon nanotube, as taught by Tsebro, because the evaporation of graphite in an electron beam is a simple and known means of fabricating carbon nanotube films (Tsebro, column 1, lines 22-23), and such a process of fabrication results in nanotube walls composed of a layer of graphite (Tsebro, column 3, lines 21-23).

Regarding claim 7, Schwarzacher fails to disclose the use of a layer of diamond.

Tsebro teaches the use of carbon layers in the channel region. Although the Bravais lattice structure of the carbon layers is not specified, the carbon layers are considered to encompass both graphite and diamond lattice structures. Assuming *arguendo*, the carbon layers taught by Tsebro do not include diamond.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify in the device of Schwarzacher as modified by Tsebro, that the carbon layer

has a diamond lattice. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to specify a diamond lattice material structure in the carbon layer taught by Tsebro, because the material lattice choice directly affects the structural and electrical properties of the material. This enables the material properties to be more specifically chosen and optimized for the material's intended use. One of ordinary skill in the art would additionally be motivated to choose diamond or graphite carbon layers in order to optimize lattice matching with the surrounding layers. Thus, it would have been obvious to specify that the carbon layers include diamond, in order to select nanotube properties and promote lattice matching over a broad range.

6. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schwarzacher in view of U.S. Patent No. 6,265,466 to Glatkowski et al.

Schwarzacher fails to disclose a nanotube made of boron nitride or of silicon.

Glatkowski discloses a nanotubes made of boron nitride and silicon (column 3, lines 19-21).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the magnetoelectric device of Schwarzacher, such that the nanotubes are made of boron nitride or of silicon, as taught by Glatkowski. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to specify that the nanotubes can be made of boron nitride or of silicon, because boron nitride and silicon are recognized in the art as equivalent nanotube materials. It is well within the purview of one of

ordinary skill in the art to select a nanotube material based on the desired material properties (Glatkowski, column 3, lines 8-23).

Response to Arguments

7. Applicant's arguments with respect to claims 1 and 13 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Patent No. 6,172,902 to Wegrowe et al. discloses magnetoelectric devices with ferromagnetic regions surrounding a nanotube. This art has an earlier priority date, but does not qualify as prior art under 35 U.S.C. 102(a) or (e).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (703) 305-3233. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (703) 305-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd
November 25, 2002


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800